8520A/PRT

Precision Temperature System

Addendum

FLUKE®

8520A/PRT

Precision Temperature System

Addendum

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Frontispiece 8520A/PRT Precision Temperature System

INTRODUCTION AND SPECIFICATIONS

Introduction

This addendum provides specifications, handling instructions, operating instructions, and theory of operation for the 8520A/PRT (Platinum Resistance Thermometer). Programming local and remote IEEE-488 functions for the 8520A/PRT Precision Temperature Measurement System are also covered.

The 8520A/PRT includes an 8520A Digital Multimeter, a precision Platinum Resistance Temperature Standard, a four (4) wire short, and a Reference Resistor Assembly. The multimeter provides high measurement accuracy and substantial math capabilities. The PRT is calibration-matched to the multimeter.

Math Program #15 computes and displays the temperature equivalent of the PRT resistance. The temperature is normally displayed in degrees Celsius, but the user may also elect to display the temperature in degrees Fahrenheit or Kelvin. Changing the temperature display is described later in this addendum.

The 8520A/PRT temperature measurement system uses the International Practical Temperature Scale of 1968 (IPTS-68) in its calculation of temperature. The system includes the Alpha, Delta, A4, and C4 parameters, in internal memory (ROM), for the particular PRT shipped with the Precision Temperature Measurement System. These parameters are used at power-up to calculate the temperature. After power-up temporary parameters may be stored to use with another probe. However, when the instrument power is cycled the temporary values will be replaced with the permanent values necessitating re-entry of the temporary parameters. Temporary parameter entry is described later in this addendum.

Specifications

Figure 1 shows the 8520A/PRT specifications for 24 hours, 90 days, and 1 year. The 24 hour specifications apply @ 23°C ±1°C. All other specifications apply over a ±5°C temperature range. For 24 hours the accuracy is 10 m°C at 0°C increasing to 15 m°C at +100°C and 20 m°C at -100°C. For 90 days the accuracy is 13 m°C at 0°C increasing to 30 m°C at +150°C and 40 m°C at -100°C. For 1 year the accuracy is 15 m°C at 0°C increasing to 50 m°C at +150°C and 55 m°C at -100°C.

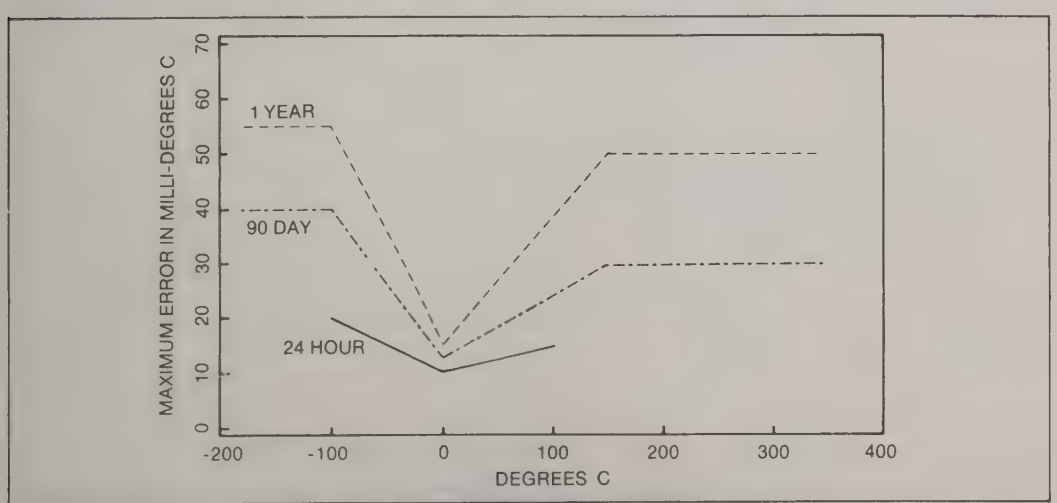

Figure 1. 8520A/PRT Temperature Accuracy

OPERATING INSTRUCTIONS

PRT Handling

The PRT is a delicate precision instrument. Always store the PRT in its box or leave it secured in a temperature bath. Never leave the PRT in any other position. Fluke is not responsible for PRT damages attributable to abuse.

CAUTION

Handle the PRT with care. The platinum lattices are more delicate than glass. Any small amount of force (such as a drop) could destroy the PRT.

PRT Setup

The calibration seal on the PRT box ensures calibration integrity from the laboratory. Do not open the box until setup is required. During the following procedure refer to Figure 2 and Table 1 titled Rear Panel Controls and Connectors, and Figure 3 and Table 2 titled Front Panel Controls, Connectors, and Indicators.

Use the following procedure to setup the PRT:

1. Break the calibration seal on the PRT box.
2. Leaving the PRT in the box, pull out the connector at the PRT cable.
3. Secure this connector to the 8520A/PRT REAR ANALOG INPUT (see Table 1).
4. Mount the PRT in the temperature bath when ready.
5. Connect the power cord and energize the 8520A/PRT. Allow a two-hour warm-up to ensure full accuracy.

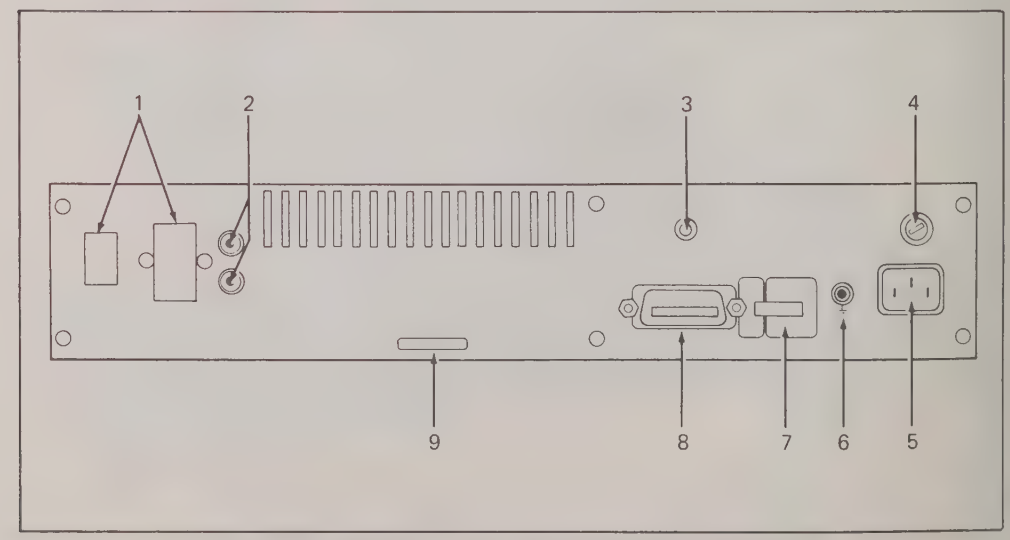

Figure 2. 8520A Rear Panel Controls and Connectors

Table 1. 8520A Rear Panel Controls and Connectors

REF NO.	NAME	FUNCTION
1	REAR ANALOG INPUTS (J6)	20 pin connector and pin assignment chart. Duplicates the function of the front panel V/Ω INPUT, Ω SOURCE, and GUARD terminals.
2	EXTERNAL REFERENCE HI Terminal (J25) LO Terminal (J26)	Binding posts. HI is red. LO is black. External reference signal is applied to these terminals.
3	BNC TRIGGER Terminal (J7)	BNC connector for input of external trigger.
4	FUSE	Line power fuse, F201, and chart listing the appropriate line power fuse for each line power configuration.
5	Line Power Receptacle	Receptacle for line power cable.
6	Terminal (J9)	Binding post connected to chassis ground.
7	IEEE-488 ADDRESS Switches	Eight recessed toggle switches.
	INST ADDRESS	Determine the IEEE-488 address of the 8520A.
	TRIGGER	Select rising or falling edge of BNC TRIGGER input for triggering.
	TALK ONLY	Enable/disable IEEE-488 Talk Only (TON) function.
	SHIELD	Connect/disconnect IEEE-488 Interface cable and 8520A ground.
8	IEEE-488 CONNECTOR	Standard 24 pin IEEE-488 receptacle.
9	Instrument Model Number and Instrument Serial Number	

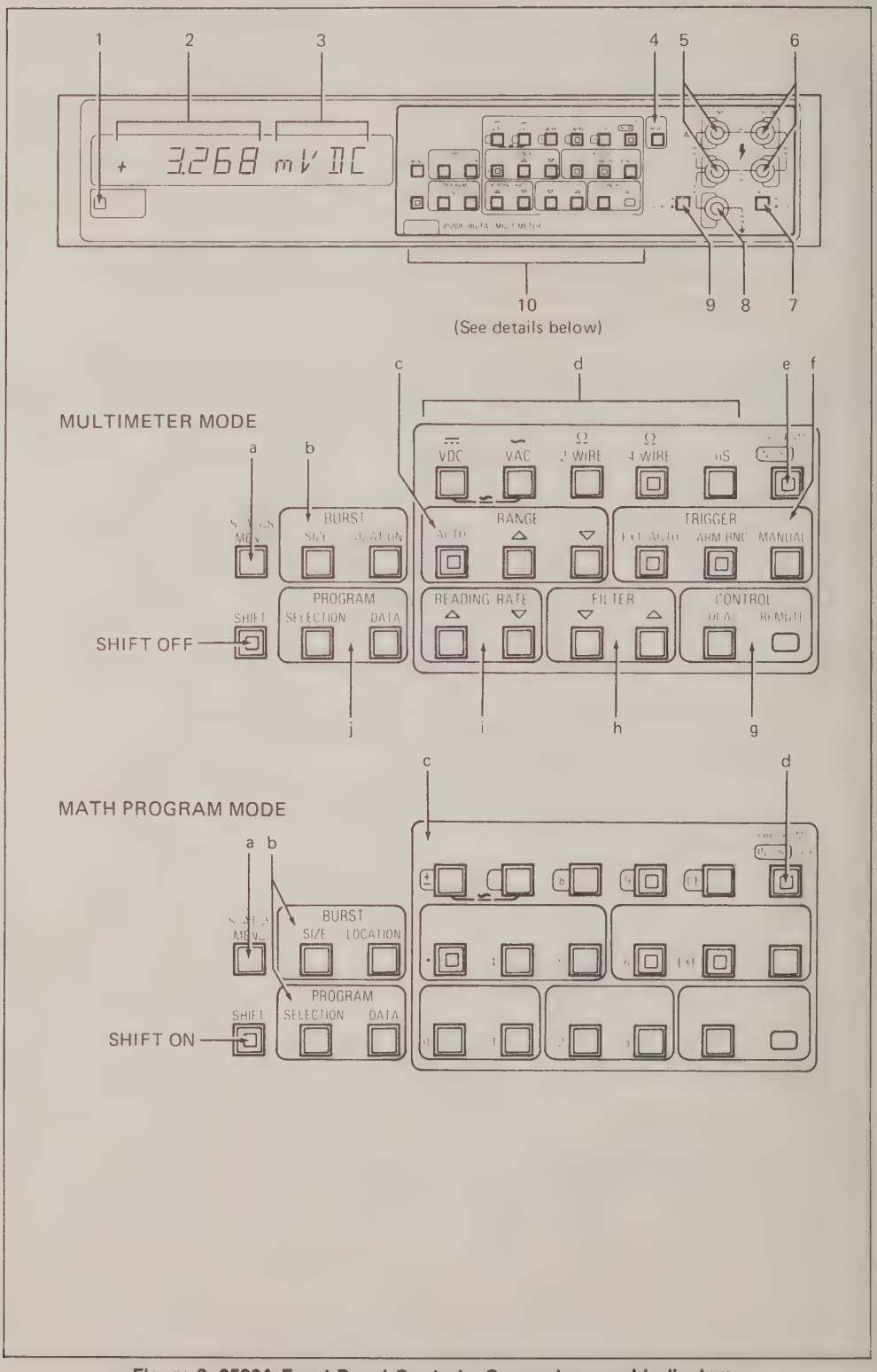

Figure 3. 8520A Front Panel Controls, Connectors, and Indicators

Table 2. 8520A Front Panel Controls, Connectors, and Indicators

REF NO.	NAME	FUNCTION
1	POWER ON/OFF Switch	Push ON (in)/push OFF (out) for line power and POWER ON default set-up (See Defaults in the Operation section of this manual).
2	Left Display	5 1/2, 7-segment LED digits with polarity indication and six decimal point positions.
3	Right Display	Four, 14-segment alphanumeric LED digits.
4	RESET Switch	Momentary contact pushbutton used to reset the instrument to two different default set-ups. (See Defaults in the Operation section of this manual.
5	V/Ω INPUT HI Terminal LO Terminal	Recessed terminals (for increased operator safety). HI is red. LO is black. Voltages and resistances to be measured are applied to these terminals.
6	Ω SOURCE HI Terminal LO Terminal	Recessed terminals (for increased operator safety). HI is red. LO is black. The ohms source output is present at these terminals when the Ω 4 WIRE measurement function is selected (the 8520A opens these terminals when any other function is selected).
7	INPUT REAR/FRONT Switch	Push to REAR (in) to connect the instrument to the Rear Analog Input terminals. Push to FRONT (out) to connect the instrument to the front panel terminals.
8	GUARD Terminal	Blue recessed terminal used for External Guard Operation.
9	EXTERNAL GUARD/NORMAL Switch	Push to NORMAL (in) to disconnect/push to EXTERNAL GUARD (out) to connect the GUARD terminal and the internal guard circuit.
10	Keyboard Switches	23 momentary pushbuttons and one indicator (REMOTE). The pushbuttons are dual function controls. Each control has one function when the instrument is in the Multimeter Mode and another function when the instrument is in the Math Program Mode. Six of the pushbuttons have an integral LED to indicate the status of the control.
	SHIFT	Push to shift between the Multimeter Mode (LED off) and the Math Program Mode (LED on).
	MULTIMETER MODE OF OPERATION (SHIFT LED off)	
a	STATUS	Push to display present function, Range, Reading Rate, and Filter.
b	BURST SIZE	Push to display current burst size.
c	RANGE	Three range controls that can enable autoranging (AUTO LED on), select the next higher (▲) or lower (▼) range.
d	Function	Five software interlocked controls that determine the measurement function.

Table 2. 8502A Front Panel Controls, Connectors, and Indicators (cont)

REF NO.	NAME	FUNCTION
e	PROGRAMS IN USE/OFF	Push to enable or disable the math program(s) selected. The math programs are in use when the LED is on.
f	TRIGGER	Three controls that determine instrument triggering.
g	CONTROL	Push LOCAL to select local (front panel) control of the instrument. REMOTE on indicates that an external device has assumed control of the instrument via the IEEE-488 interface.
h	FILTER	Push to decrease (▼) or increase (▲) settling time and rejection of filter.
i	READING RATE	Push to select next faster (▲) or next slower (▼) Reading Rate.
j	PROGRAM SELECTION	Push to display the number(s) of the math program(s) selected.
	MATH PROGRAM MODE OF OPERATION (SHIFT LED on)	
a	MENU	Push and release to step or push and hold to scroll through the menu of math programs.
b	Numeric Terminator Buttons	Four controls used after Numeric Keyboard entries.
	BURST SIZE	Used following Numeric Keyboard entries to program burst size.
	LOCATION	Used following Numeric Keyboard entries to display the contents of any location in burst memory.
	PROGRAM SELECTION	Used following Numeric Keyboard entries to select math programs and to enter data.
	DATA	Used following either a Numeric Keyboard entry or use of the MANUAL TRIGGER control to store and enter data.
c	Numeric Keyboard	Controls used to enter numeric values, to select math programs, or retrieve constants or data.
d	PROGRAMS IN USE/OFF	Used to enable or disable the math program(s) selected. The LED on indicates that the selected math programs(s) are in use.

Temperature Measurement System Operation

The 8520A/PRT is an accurate temperature measurement system. In order to assure and maintain the accuracy certain procedures must be performed. These procedures are described in the following paragraphs.

MAINTAINING A DAILY RECORD SHEET

A daily record sheet must be maintained. This record keeping and proper calibration are necessary to keep the thermometer within specifications. Table 3 shows a sample record sheet. Zero and gain must first be determined. First use the Ice Bath Method described below. After this the Standard Resistor Method may be used.

Table 3. Record Sheet

Date	Zero r15.8	Std. Temp. °C (a)	Indicated Temp. °C (b)	Gain °C (a)-(b)=r15.9	Std. Res. Temp. °C
4-8-86	-0.008	0.000°C	-0.0054°C	+0.0054°C	+0.0090

ZERO AND GAIN CALIBRATION

The Ice Bath Method and Standard Resistor Method procedures compensate for instrument and probe drift. They also complete the matching of the probe to the DMM. Initially, zero and gain are determined using the Ice Bath Method. A calibrated ice bath guaranteed to within 0.002°C is required. A Rosemount 911A is suitable for this purpose. After this is completed and a table similar to the one above is made, the Reference Resistor Assembly that comes with the 8520A/PRT can be used to compensate for normal instrument drift by following the procedure titled Standard Resistor Method.

Ice Bath Method

The Ice Bath Method procedure requires that the PRT probe be immersed at least four inches in a calibrated ice bath. There are two parts to this procedure, a ZERO CORRECTION and a GAIN CORRECTION. Compute and enter both the ZERO CORRECTION and the GAIN CORRECTION using the following procedure:

1. ZERO CORRECTION

   A. Connect the Rear Input Short to the 8520A/PRT.

   B. Select the 4 WIRE resistance mode.

   C. Select program 15 (SHIFT 1 5 SELECTION). The 8520A/PRT responds with:

      15=PRT

      Then:

      r15.8=ZERO

   ALLOW ≥ 5 MINUTES BETWEEN STEP A + STEP D

   D. Press the "MANUAL" button and wait for a reading.

   ENTER DATA IN COLUMN LABELED "ZERO r15.8"

   E. Press the "DATA" button. The 8520A/PRT responds with:

      r15.9=GAIN

2. GAIN CORRECTION

   A. Remove the Rear Input Short.

B. Connect the PRT probe to the rear input.
WAIT 25 MINUTES BEFORE CONTINUING

C. Press:

[0] [DATA]

D. Press:

[PROGRAMS IN USE]

The LED titled PROGRAMS IN USE comes on.

E. Average several readings to compensate for digital rattle. Use the average as the indicated temperature figure for the PRT Record Sheet.

F. Compute the GAIN by subtracting this indicated temperature from the temperature of the ice bath. Enter this number in the PRT Record Sheet and in r15.9 of the 8520A/PRT.

Register r15.9 entry is accomplished by pressing the front panel buttons as follows:

[SHIFT] [1] [5] [.] [9] [SELECTION]

⟨numeric value⟩ DATA

G. Enable temperature measurements by pressing:

[PROGRAM IN USE]

Standard Resistor Method

The Standard Resistor Method uses the Reference Resistor Assembly (a 100 ohm standard resistor) supplied with the 8520A/PRT, to compensate for normal instrument drift. This method assumes that there has been no deterioration to the PRT probe since the last ice bath calibration. Perform the following procedure:

1. Perform the initial Ice Bath Method procedure.

2. Replace the PRT probe with the Reference Resistor Assembly by disconnecting the PRT probe from the 8520A/PRT rear input connectors and connecting the Reference Resistor Assembly to the 8520A/PRT rear input connectors.

3. Record the temperature indicated on the front panel of the 8520A.

Future zero and gain calibrations can be checked and reprogrammed by following the Ice Bath Method and substituting the Reference Resistor Assembly and its temperature reading for the PRT probe in the ice bath.

Front Panel Operation

Use the following procedure to select and implement program 15 when using the 8520A/PRT from the front panel:

1. Connect the PRT probe to the rear input of the 8520A/PRT.

2. Select REAR INPUT on the 8520A.

3. Select 4 WIRE ohms.

4. Press the following buttons in sequence and verify the response of the 8520A/PRT:

Press	Response
[SHIFT]	"?" NMBR
[1] [5]	15 NMBR
[SELECTION]	r15.8=ZERO
	xxxxx ZERO
[DATA]	r15.9=GAIN
[DATA]	The DMM is now reading the resistance of the probe.
[PROGRAMS IN USE]	The DMM is now reading in °C.

Changing Probe Constants

The 8520A/PRT is shipped with the constants of the PRT stored internally in a PROM. Also, the probe serial number is stored in register 16. Temporary constants may be stored at any time to allow the use of other PRTs. Multiple PRTs may be used by storing new constants with each probe change. Again, these are temporary only and will not remain after power is removed from the instrument. The following procedure describes how to store these temporary constants:

1. Select the desired register by pressing:

   [SHIFT] [1] [5] [.] [X] [SELECTION]

   "X" represents the register number (3,4,5,6, or 7).

   The display first shows the register number and name, then the register value.

2. With the old register value displayed, enter the new value.

3. Complete the entry by pressing:

   [DATA]

   At this time the next higher register number and name, then value will be displayed. With the old value displayed, the new value may be entered as above.

4. This process will repeat itself until the last register is displayed and entered. Data entry may be skipped by pressing the DATA button when the register value appears.

Remote (IEEE-488) Operation

Remote commands offer simplified operation over Front Panel Operation of the 8520A/PRT. Two additional programs are available over the standard 8520A Instruction Set. These programs are Program 15 (the PRT program), and Program 16 (the PRT Probe Serial Number program).

Program selection is accomplished by transmitting "P15," across the interface. Note that this does not implement or enable the program, it only identifies this as the program to be used when you are ready to do so. The selected program is enabled by transmitting "M1," to the DMM. Now the PROGRAMS IN USE button will light. These commands can be combined to select and enable the program simultaneously by sending "P15M1," to the 8520A/PRT.

It is possible to select and enable up to three (3) programs at a time. This results in the output of one program feeding the input of the program following it. Program execution is in the order of program selection. Also, Programs 11, 12, 13, and 14 should not be selected with Program 15.

New probe constants or zero and gain values can be entered at any time by using the Keep Register (KR ⟨register number⟩ / ⟨value⟩) command. Refer to Table 5 for the registers associated with Program 15. The Get Register (GR register number) command can be used to examine the contents of these registers.

Temperature Range and Resolution

The temperature range for the 8520A/PRT Temperature Measurement System is -183°C to +350°C. The upper temperature limit may be greater than +350°C and is dependent on the resistance characteristics of the PRT probe.

Temperature measurements may be made to 1 m°C resolution from -199.999°C to +199.999°C. Readings from +200.00°C to +350.00°C have a resolution of 10 m°C.

Displaying Degrees Fahrenheit or Kelvin

The 8520A/PRT default temperature reading is in degrees Celsius. The readout can be changed to degrees Fahrenheit or Kelvin by using the following procedure:

1. Press:

   [SHIFT] [.] [1] [SELECTION]

2. For degrees Fahrenheit, press:

   [1] [5] [.] [1] [DATA]

3. For Kelvin, press:

   [1] [5] [.] [2] [DATA]

4. To resume the degrees Celsius display, press:

   [SHIFT] [.] [1] [SELECTION] [1] [5] [.] [0] [DATA]

Table 4. Instruction Set

FUNCTION

V	VDC
VA	VAC
VC	DC+AC V
Z2	2 Term OHMS
Z3	Nano Siemens
Z4	4 Term OHMS

"R3R7D8F5M0N5," is performed also.

Z3 performs "R4D8F5M0N5,"

RANGE

R0	100 mVDC, 10 OHMS
R1	1 VOLT, 100 OHMS
R2	10 VOLT, 1000 OHMS
R3	100 VOLT, 10K OHMS
	R4, R5, R6=Hi Ohms
R4	1000 VOLT, 100K OHMS
	100 nSiemens
R5	AUTO VOLT,1M OHMS
R6	AUTO VOLT, 10M OHMS
R7	AUTO RANGE
R8	FIX RANGE

When in ohms and the reading rate is faster than D6, R4 thru R6 will be converted to R3.

TRIGGER

T0	Internal trigger (continuous)
T1	External trigger

PROGRAMS IN USE/OFF

M0	Programs off
M1	Programs "IN USE"

READING RATE

DC volts and Low Ohms

	Readings/second			deflt filter
D0	ASYNChronous			F0
	400Hz	60Hz	50Hz	
D1	228	240	200	F0
D2	114	120	100	F0
D3	57	60	50	F1
D4	38	40	40	F1
D5	19	20	20	F2
All functions and ranges				
D6	9.5	10	10	F3
D7	4.8	5	5	F4
D8	1.9	2	2	F5
D9	1	1	1	F6
	Readings/minute			
D10		30		F6
D11		12		F6
D12		6		F6
D13		2		F6
D14		1		F6
	Readings/hour			
D15		30		F6
D16		12		F6
D17		6		F6
D18		2		F6
D19		1		F6

400 Hz is .03% fast for reading rates slower than 2/sec.

Note that the "D" command changes the filter.

When in ohms and R4 thru R6, D0 thru D5 are converted to D6.

FILTER

	DC volts : Lo Ohms :	AC volts DC+AC	: Hi Ohms : nSiemens
F0	5mSEC	100mSEC	FAST
F1	25mSEC	100mSEC	FAST
F2	50mSEC	100mSEC	FAST
F3	100mSEC	100mSEC	FAST
F4	200mSEC	200mSEC	FAST
F5	500mSEC	500mSEC	FAST
F6	1000mSEC	1000mSEC	SLOW

FAST = 300mSEC max

SLOW = 4000mSEC max

Table 4. Instruction Set (cont)

BURST MEMORY CONTROL

Bn Burstsize = n; max n = +/–999
GMn Transmit memory location
max n = +/–999
Wn/m Transmit memory from n to m
max n,m = +/–999
Yn/m Scan memory from n to m
(W and Y perform selected math if 'M1' is active)

PROGRAMS

P0	"NONE" program *
P1	TEST *
P2	ZERO
P3	EXTERNAL REFERENCE
P4	OFFSET, SCALE, RATIO
P5	PERCENT DEVIATION
P6	PEAK VALUES
P7	LIMITS
P8	STATISTICS
P9	LF RMS
P10	DB RATIO
P11	RTD TEMP CONVERSION
P12	80T-150 C PROBE
P13	80T-150 F PROBE
P14	THERMISTOR CONVERSION

Pabc = up to 3 programs allowed
* may not be grouped
P11, 12, 13, 14,should not be grouped with each other.

MATH PROGRAM REGISTERS

GRr	Transmit register r
KRr/v	Keep data v in register r

STATUS

GF	Transmit full status
GS	Transmit short status
KEs	Keep 's' as error response
KVs	Keep 's' as overrange response

IMMEDIATE CHARACTERS

*	Reset to default state
%	Force 8520 to look at command buffer and clear 8520 output buffer
&	Clear serial poll "rsv"

*,% both output one byte to 488 bus

TERMINATOR COMMANDS

,	Execute command string
?	Execute, trigger, and transmit
!	Execute, arm BNC trigger, and transmit

MISC CONTROL

x=N or I (i.e. N1 or I1)

x1	Front panel on/off
x2	Filter timeout on/off
x3	Linefeed yes/no
x4	ASCII/binary
x5	Normal/High speed
x6	EOI on/off
x7	Lock/Unlock reading transfer

SERIAL POLL

Si jkm Enable serial poll option
0001 Output ready, Overrange, Error
0002 Overrange
0004 Error
0010 End of burst
0020 New high peak
0040 New low peak
0100 Reading HIGH
0200 Reading PASS
0400 Reading LOW
1000 LFAC reading ready
2000 undefined
4000 undefined
Acceptable forms
Sm, Skm, Sjkm, Sijkm
S1=S01=S001=S0001
Add options for multiple SRQ
S11=Output ready, end of burst

Table 5. Program Registers

REGISTER NUMBER	RIGHT DISPLAY	DESCRIPTION	FORMULA	DEFAULT VALUE
r15.0	°C	PRT °C	T	0
r15.1	°F	PRT °F	1.8T + 32	0
r15.2	K	PRT Kelvin	T + 273.15	0
r15.3	R_0	PRT resistance	R_0	100
r15.4	ALPH	Alpha		
r15.5	DELT	Delta		
r15.6	A4			
r15.7	C4			
r15.8	ZERO	Offset		
r15.9	GAIN	Gain		

1. The raw measured value of resistance (R^1t) is adjusted for offset:
   $Rt = R^1t$ - r15.8.

2. The gain error is adjusted by recalculating:

$$R_0 = r15.3 - \frac{r15.9}{2.5}$$

Thus:

$$W(t) = \frac{R(t)}{R_0} = \frac{R^1(t) - r15.8}{r15.3 - \frac{r15.9}{2.5}}$$

Displaying the PRT Serial Number

The serial number of the PRT probe supplied with the 8520A/PRT may be accessed by pressing:

SHIFT 1 6 SELECTION

THEORY OF OPERATION

Temperature Calculation

The 8520A/PRT operates by measuring the resistance of the PRT probe and then calculating the temperature. Positive temperatures, 0°C to 350°C, are based on the IPTS-68 interpolation formulae. Negative temperatures, 0°C to -183°C, are based on an approximation to the IPTS-68 formulae.

ERROR Analysis

An understanding of error analysis is essential in achieving accurate temperature measurements. The following paragraphs outline possible error sources and cures.

OFFSET ERRORS

All three of the following offset errors must be considered. Subsequent adjustments for linear and nonlinear errors become invalid if the offset errors have not been compensated for first. For example, if zero offset is not corrected, adjusting gain at ice-point creates large errors at other temperatures.

Zero Error (8520A/PRT)

The user of any digital multimeter may encounter a significant zero error. For example, an offset of only a few milli-ohms will cause a significant error in temperature measurement. This can be corrected on the 8520A/PRT by entering the zero offset in register r15.8. The procedure for doing this is described in the Theory of Operation section of this addendum.

Thermal EMF (PRT)

A thermal emf of several microvolts may appear at the 8520A/PRT input if there is a temperature gradient from the tip of the probe up to where the platinum element is connected to the output leads. In the 8520A/PRT this equates to +2.5 m°C per -1 micro-volt.

EMI Pickup

The PRT cable is shielded and properly guarded to minimize EMI pickup. However, strong microwave radiation can cause induced emfs to appear as a fluctuating offset error. This problem must be cured by changing the proximity of the PRT to the radiation source.

8520A/PRT DMM ERRORS

Component instability with changes in time and temperature cause most of the DMM errors. Time instability is unavoidable. Temperature instability is caused by the difference between ambient temperatures at calibration and operation. This difference can be minimized by using the instrument in approximately the same environment.

Scaling Error

A scaling error is defined as a linear time and temperature instability. Compensation for scaling error can be made using software register r15.9.

Non-Linear Error

Software compensation is not made for non-linear time and temperature instability. This is compensated for through manual instrument calibration.

PRT ERRORS

Normal PRT Error (Repeatability)

Repeatability defines the ability of the PRT to return to the same bath resistance value when repeatedly placed in and out of a constant temperature bath. The thermometer accuracy specification incorporates this repeatability to the equivalent of 3 m°C. The probe thermal history in between returns to the bath affects the actual repeatability specification.

Normal PRT Error (Hysteresis)

All PRTs exhibit hysteresis during temperature changes. The cycle of change for the PRT must be within the range of operations (-183°C to +350°C). The PRT exhibits hysteresis of less than 0.001% of the temperature span. The worst case hysteresis error (at mid-span) is incorporated in the thermometer accuracy specification.

PRT Calibration Error

The temperature probe is calibrated against a primary standard PRT (SPRT). The thermometer accuracy specification incorporates any uncertainties resulting from this calibration.

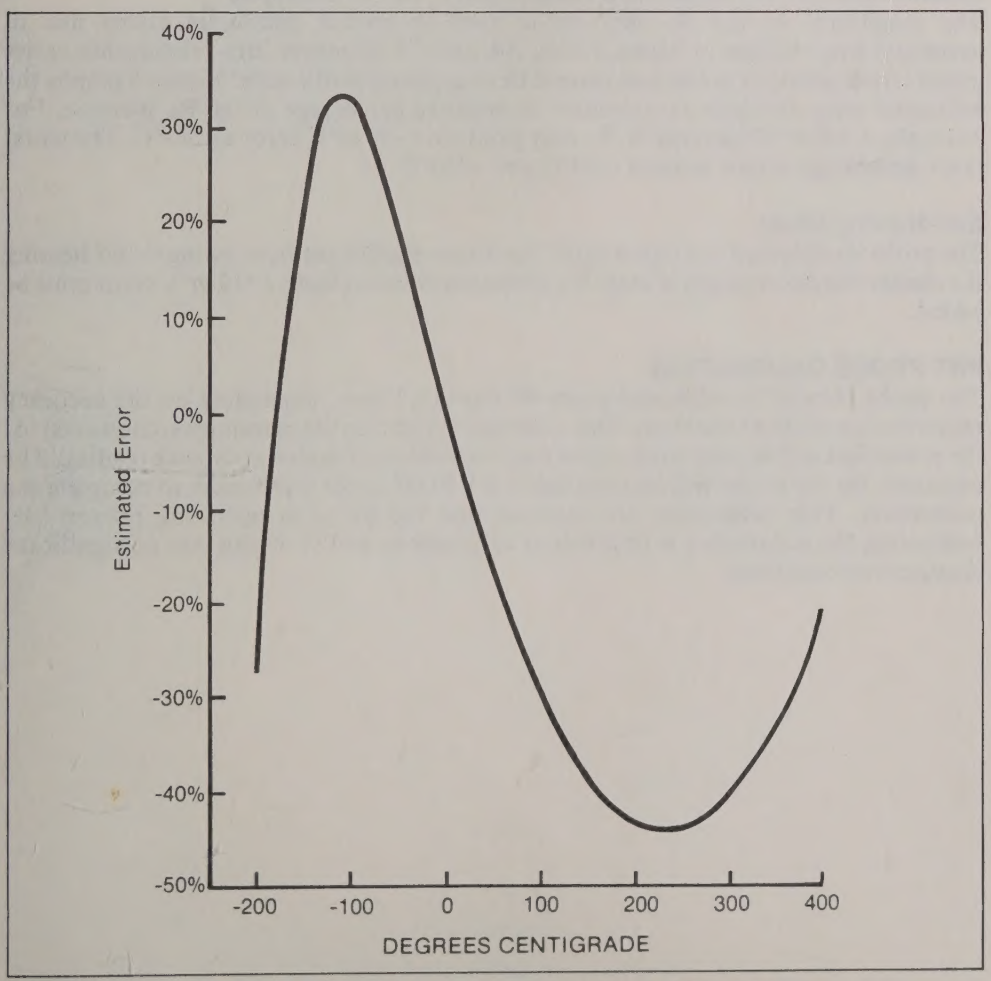

Figure 4. Estimated Errors as Percentage of R_0 Increase

Deterioration of PRT Calibration (R_0 Increase)

Constant exposure to high temperature causes irreversible change to the PRT. Resistance at ice point (R_0) is most noticeably affected. Constant immersion at 400°C can produce an R_0 increase equivalent to 25 m°C/100 hours. For example, after 300 hours, R_0 may show 0.075°C at ice point. Although this R_0 increase is cumulative, a leveling off after the first 500 hours is commonly observed. Exposure to temperatures more than 400°C causes more severe R_0 increases.

Severe mechanical shock to the platinum molecular lattice also increases R_0. The amount of change depends on the magnitude of the shock. The metallic sheath on the PRT makes the probe appear more rugged than it really is. Extreme caution in handling the PRT cannot be over emphasized. The platinum molecular lattice in the PRT is more delicate than glass.

Software compensation (r15.9) can be made for an increase in R_0. However, most incidences of R_0 increase are accompanied by changes in Delta, Alpha, A4, and C4. These changes can only be eliminated by PRT recalibration.

Deterioration of PRT Calibration (Delta, Alpha, A4, C4 Changes)

The magnitude of the R_0 increase is used to predict maximum errors due to accompanying changes in Alpha, Delta, A4, and C4. However, this relationship varies greatly from probe to probe and cannot be considered predictable. Figure 5 graphs the estimated error envelope as a positive or negative percentage of the R_0 increase. For example, a 100 m°C increase in R_0 may produce a -45 m°C error at 240°C. The worst error percentage occurs around -110°C and +240°C.

Self-Heating Effect

The probe is calibrated in a liquid bath. There is no significant error owing to self-heating if a similar (liquid) medium is used. If a gaseous medium is used, a +12 m°C error must be added.

PRT PROBE CALIBRATION

The probe should be calibrated every 90 days or 1 year, depending on the accuracy requirements of the application. This calibration results in the parameters (constants) for the probe that will be used to calculate the temperature from the resistance reading. The constants for the probe will be installed in a PROM in the instrument to complete the calibration. This calibration also assures that the probe is operating properly by comparing the parameters with previous calibrations and verifying that no significant changes have occurred.